

EFFECTS OF MECHANICATION AND HANDLING ON CHERRY QUALITY

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Maintenance of quality was one of the first incentives for seeking new methods of harvesting tart cherries (Figure 1). Studies conducted in 1949-52 pinpointed the bruise damage done by hand pickers as the prime cause of cherry scald (Figure 2), a serious quality defect [34, 35, 36, 37]. If bruising were avoided during harvest, cherries could be held for several days at warm temperatures without scalding.

Two new methods of harvesting that might reduce bruising were tested. One method, employing a suspended minnow net for catching hand loosened fruit, cut scald counts in half [38, 39]. The second method, involving the manual shaking of small branches, gave no advantage in scald count, but greatly accelerated the rate of harvest.

Cooperative Research

In 1956 agricultural engineers of the U.S. Department of Agriculture at Michigan State University began to build equipment for mechanizing the tart cherry harvest [6, 10, 26]. The objectives were to reduce the number of hand pickers required for harvesting, and to cut harvesting costs. In 1959 the engineers and the food scientists of this laboratory (Eastern Utilization Research and Development Division) joined together to form a balanced research team for attacking a wide variety of problems. At this time also scientists of Cornell University and the New York State Agricultural Experiment Station began studies on cherry harvesting [4, 13, 16, 17, 27]. In general, the findings of the Michigan, Pennsylvania, and New York groups have consistently been in agreement.

Early Trials

In 1959 mechanical harvesting of cherries was a new concept. The concept immediately met bias and resistance from many sources. Only a few of the most progressive growers and processors were willing to participate in the first commercial trials.

The machine harvesting of 3,000 trees in Michigan and New York in 1959, plus the processing of the fruit (blended with handpicked lots), marked the dawn of a new era in the cherry industry [13, 26]. The results showed convincingly that: (1) cherries could be separated from trees by mechanical shaking; (2) shaking did no serious damage to trees; and (3) fruit quality, with care, could be maintained.

From a quality standpoint, machine harvested cherries (1959) differed from hand picked lots in three main ways: (1) the average machine harvested fruit was more bruised; (2) had more attached stems; and (3) was mixed with more trash. Otherwise, the machines had little effect on quality. In general,

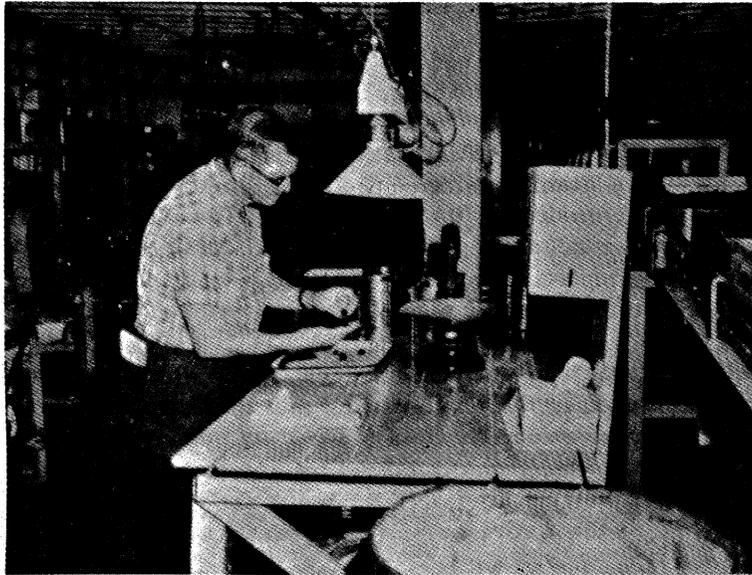


Figure 1. Quality is an important factor in determining cherry worth. During mechanization, quality must be maintained.

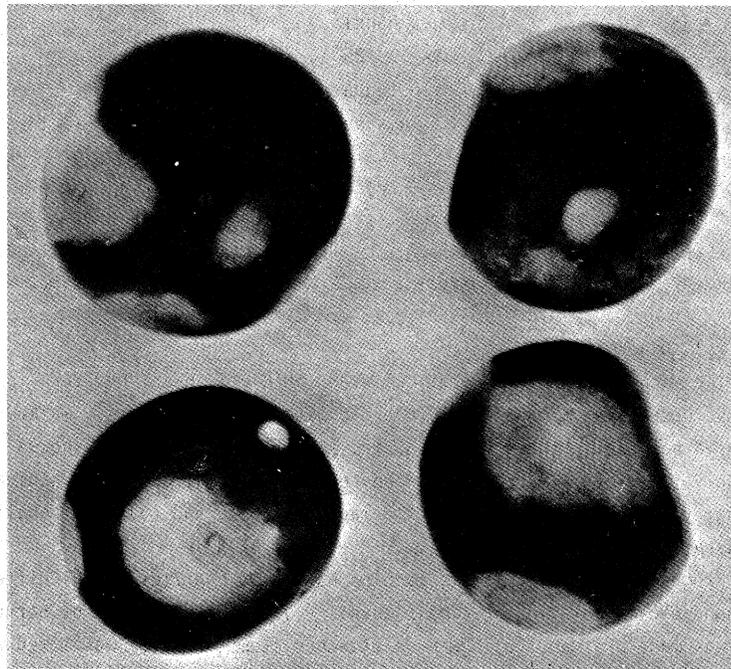


Figure 2. Scald blemishes on cherries can be avoided when proper harvesting and handling techniques are followed.

harvest quality reflected on-the-tree quality, since shake harvesting did not effectively separate undercolored or blemished fruit from good fruit [13, 26].

Solving Quality Problems, 1959-67

Each year gains were scored in overcoming problems concerned with cherry quality [1, 2, 3, 5, 8, 18, 19, 21, 22, 24, 30, 39, 43]. In most cases the new knowledge could be applied profitably to both machine harvested and hand-picked fruit. Some of the notable gains are listed in the following section.

Abolishing Scald

Although scald can be abolished by eliminating harvest bruising [14, 15, 20, 33, 35, 40, 46, 47, 48], it is not practical to completely eliminate this bruising. Fortunately, an alternative and practical means of controlling scald has been found [16, 26]. If cherries are cooled (and maintained) in water at about 55°F. within one-half hour after harvest (Figure 3), and if they are not disturbed in their original containers thereafter (Figure 4), they can be held for 24 hours without developing scald. If, however, the cherries are not cooled quickly, or if they are dumped from one container to another (Figure 5) or are rehandled in any way, they scald within an hour or two. Unfortunately, most of the cherry industry has not yet (1968) capitalized on these findings.

Bulk Handling and Trash Removal

The use of water for the bulk handling of machine harvested cherries has increased steadily since 1959 [11, 25, 26]. A standardized system has evolved in which cherries are collected at the harvester in tanks (1/2-ton capacity) containing cold water. This system has 3 quality advantages over the lug handling system: (1) cherries fall into water instead of onto dry cherries, thus minimizing bruising; (2) cherries can be cooled quickly and economically; and (3) trash (leaves, twigs, dried pits, etc.) can be removed from the cherries by skimming [8, 26].

Electric Sorting Machines

In 1963 electric sorting machines were used in the cherry industry for the first time [41, 42]. Within a year or two the machines were improved substantially and became adopted widely. The units are particularly effective in eliminating cherries blemished with wind-whip, limb-rub, and decay. Unless the units are installed properly, however, they cause bruise damage that lowers drained weight [41].

Destemmer Removes Bottleneck

Prior to 1966 the doors of many canneries were closed to machine harvested cherries, partly because no practical destemmer was available. In some tests, high stem counts (5% to 15%) cut plant capacity by 20% to 25% [39].

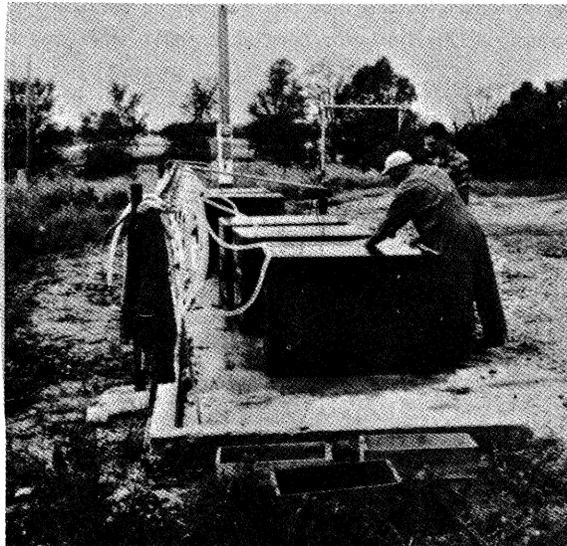


Figure 3. Cherries should be cooled to 50-55° F. immediately after harvest at a cooling station in the orchard.

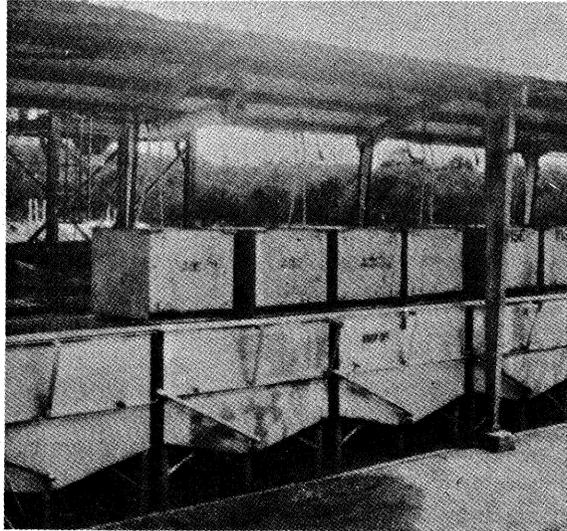


Figure 4. At the cannery, cherries should be held in original orchard tanks (smaller tanks in photo) until time for processing.

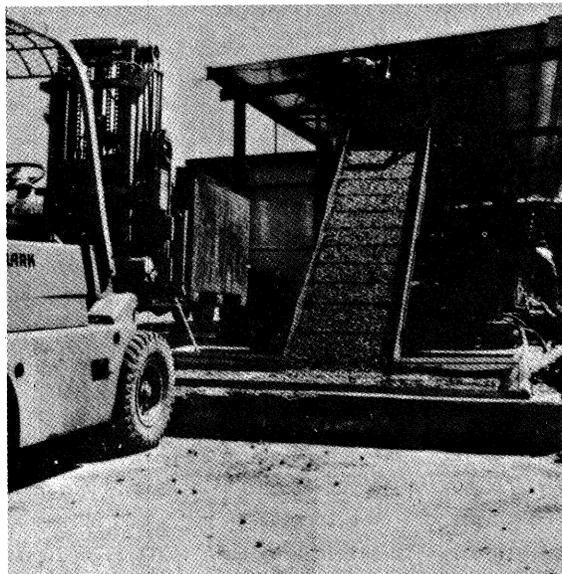


Figure 5. If cherries are transferred from orchard tanks to cannery tanks (rehandled) and soaking continues, scald develops quickly.

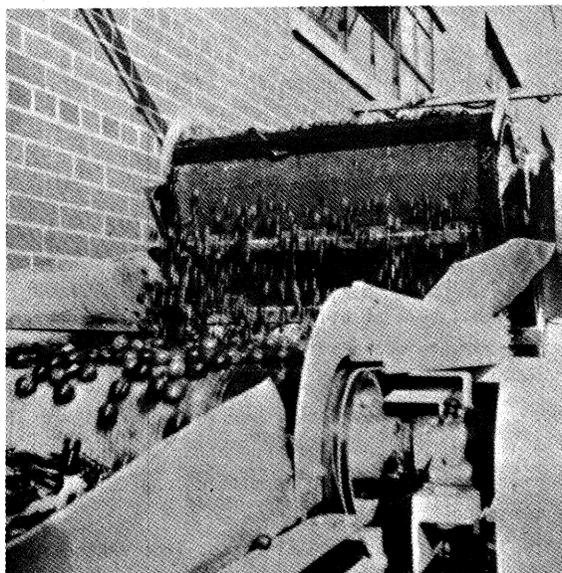


Figure 6. Rough handling of cherries at canneries causes scald and low processed yield.

Fortunately, the stem bottleneck was broken by the invention and development of the R and V destemmer in 1965-66 [10]. The destemmer causes essentially no bruise damage.

Bruise at Cannery

The coming of mechanical harvesters focused attention on harvest bruising [1, 2, 16, 39, 43]. Should attention be focused also on bruise damage during handling and processing operations? Indeed, studies have shown that bruise damage at receiving stations and canneries (Figure 6) often equals or exceeds that of harvest time [36, 43, 45]. The rehandling bruise (avoidable) severely hurts quality and processed yield [19, 40, 43, 45]. Although a few processors have taken steps to reduce postharvest bruising, much remains to be done in this area.

Quality and Crop Shortages

Size of the cherry crop is one of the main factors governing cherry quality. In years of a short crop, demand is heavy and prices are high. Processors vie with each other to obtain available fruit regardless of quality. In fact, quality requirements may be waived. Inferior equipment and shortcut procedures find their way into harvesting, handling, and processing operations. Quality tends to drop [45].

To maintain quality over the years, supply should be stabilized. This can be done by finding practical means for preventing spring freezeouts, or by stock-piling processed cherries to cover a year of crop failure. Stabilization of supply is perhaps the major problem of the tart cherry industry.

Experiences in 1968

Quality Dropped

From 60% to 80% of the tart cherries packed in Michigan in 1968 were inferior in quality. Why? Have we failed to communicate our research findings; is the cost of applying the findings too high; or are the decision makers indifferent, skeptical, or afraid to lead?

In 1968, cherries were downgraded chiefly for scald, undercolor, and mushiness. The blame should be shared by both growers and processors. Growers harvested cherries before they were ripe (this caused excessive bruising), and failed to cool them within one-half hour after harvest. Processors rehandled cherries repeatedly, and often permitted long delay periods between harvesting and processing (Figure 7).

The extent of loss to an average processor from rehandling in 1968 is indicated by the data of Table 1. Rehandling increased scald counts from 3% to 43% and decreased pitted yield by 7.1%. The estimated dollar loss per 5,000 tons (from decreased yield) amounted to \$213,000 (when product is worth 30¢ per pound).

| Cherries and Treatment | Scalded Cherries at Processing Time (Est.) | Yield of Pitted Cherries from 100 lbs. of Fresh Fruit (Accurate) | Loss to Processor from Reduced Yield per 5,000 Tons of Fruit (Est.) |
|---------------------------------------|--|--|---|
| 1. Bruised at harvest, not rehandled. | 3% | 82.8 lbs. | 0 |
| 2. Bruised at harvest, rehandled. | 43% | 75.7 lbs. | \$213,000 |

Cooling Stations Help Quality

About 400 Michigan growers have constructed facilities for cooling and soaking cherries in the orchard [11]. Cherries in 1/2-ton tanks are brought to the cooling area immediately after harvest where they are flushed with large volumes of water at about 50°F. This practice is desirable because: (1) orchard heat is removed quickly and cheaply; (2) cherries are not disturbed or rehandled; and (3) cherries can be stock-piled without deterioration until delivery time.

Scheduling is Desirable

In 1968 some processors, in cooperation with growers, set quotas and delivery schedules. The system worked splendidly and had several advantages: (1) efficiency was increased, since harvesting operations were tailored to plant needs; (2) quality was maintained, since delays at delivery time were avoided (Figure 7); (3) processed yield increased, since overloading of the cannery (spilling and mishandling of fruit) was avoided; and (4) schedules were dependable, since mechanical harvesters can operate during day or night, on holidays, and in rain.

Buying by Volume

Millions of pounds of tart cherries were bought and sold on a volume basis for the first time in 1968 [31]. Growers delivered cherries to processors in calibrated 1/2-ton tanks. Fruit depth in water was measured with a differential probe and cherry volume was calculated. The advantages of this system are: (1) quality is protected, since cherries are not rehandled or rebruised; (2) growers are paid premiums for unbruised fruit, since fewer pounds of unbruised cherries are required to fill a given volume than is the case with badly bruised fruit; and (3) the method is rapid, relatively accurate, and inexpensive.

Rural Area Development

The rise of cooling stations, orchard soaking, and delivery schedules,

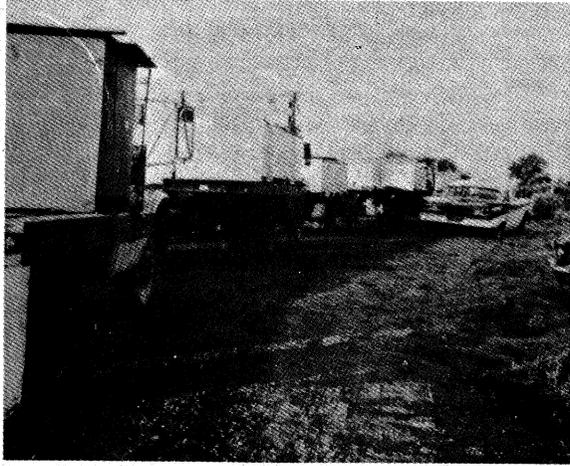


Figure 7. Delays at canneries prior to unloading cause quality deterioration. Delivery schedules are desirable.



Figure 8. Migrant workers probably will not be available for harvesting sweet cherries in the future.

marks a trend. One might say that canneries are shrinking and orchard operations are expanding. Growers, in close cooperation with fieldmen from the canneries, are assuming responsibility for the first steps of processing, and are delivering to the cannery fruit that can be fed directly onto the processing lines [21]. This trend will continue, since it makes possible the packing of high quality fruit in good yield at minimum cost.

People and Quality

Quality depends on each team member doing his job well. The person who prepares the orchard, prunes the trees, decides on maturity, operates the shaker, delivers the fruit, or runs the cannery, has an important bearing on quality. The future will see increased emphasis on the selection of quality personnel.

Sweet Cherries

Many Michigan and New York fruit growers raise both tart and sweet cherries. Since about 65% of the tart cherry crop is now harvested by machine, the need for hand pickers is disappearing. Can we expect migrant pickers to come to the orchards to pick sweet cherries only? (Figure 8)

Solving No. 1 Problem

The main difficulty retarding mechanization of the sweet cherry harvest has been the difficulty of separating fruit from the tree [7, 12, 28]. Except for the Schmidt variety, recoveries have been low in all experimental tests. Most sweet varieties in eastern United States are picked at an immature stage for the brining market. Stem attachment forces, of course, are high.

Studies have shown, however, that most sweet varieties can be harvested mechanically in high yield when the fruit becomes mature [9]. Waiting for maturity, therefore, is one answer to the No. 1 problem. Moreover, as the cherries mature, they increase rapidly in size and soluble solids content. Some growers would obtain a 25% increase in tonnage by delaying harvest. On the other hand, an increase in on-the-tree defects occurs [9, 29, 32]. In our tests, the gain in fruit weight has more than offset the loss from defects.

Delaying the harvest of Napoleon cherries produces no new processing problems. The mature fruit bleaches to a desirable light color in brine, and the blemished fruit is removed automatically with electric sorters. With Windsor cherries, however, maturity brings increased redness of flesh. Cherries do not bleach properly and grade scores drop. The trend in Michigan, therefore, is to replace Windsor plantings with the Napoleon variety when cherries for brining are desired. Meanwhile, new brining procedures may assist processing [23].

Harvesting Schmidt Cherries

Most Schmidt cherries in Michigan are allowed to ripen and are used for

canning (syrup hot-pack). They can be harvested mechanically (small and medium size trees) with equipment designed for tart cherries. Recoveries are high and bruise damage is slight. Cherries are collected dry in bulk boxes, and trash is removed by hand, by blower, or by flotation in water at the cannery. The R and V destemmer has been fairly effective in removing attached stems. In brief, mechanical harvesting of Schmidt cherries is practical from both cost and quality standpoints.

Treatment of Bruised Fruit

The bruising of Napoleon and Windsor cherries during harvest normally results in the downgrading of the brined product. The bruised fruit do not bleach properly, but remain dark and mottled. This undesirable effect can be largely overcome, however, if brining is done in the orchard immediately after harvest instead of at the processing plant after a delay period [23, 28, 29, 32, 48].

Many quality problems not yet defined will come to light as the sweet cherry harvest becomes mechanized. Our aim is to meet the problems directly and with the aid of growers, equipment manufacturers, and processors to solve them quickly.

REFERENCES CITED

- [1] Andrus, M. "Differential in Quality Between Hand Picked and Mechanically Harvested Red Tart Cherries." Progress Report. Mich. Dept. Agr., Agr. Mktg. Div., p. 10, 1966.
- [2] Bedford, C. L. "The Quality of Handpicked and Mechanically Harvested Processed Red Cherries." *Mich. State Hort. Soc.*, 92nd Ann. Rpt., 1962, pp. 94-96, 1963.
- [3] _____ . "Comparison of Mechanically Harvested and Handpicked Cherries After Processing." *Mich. State Hort. Soc.*, 94th Ann. Rpt., 1964, pp. 87-90, 1965.
- [4] Cain, J. C. "Mechanical Harvesting of Sour Cherries: Effects of Pruning, Fertilizer, and Maturity." *Proc. N. Y. State Hort. Soc.*, Ann. Mtg., pp. 198-203, 1961.
- [5] Diener, R. G.; Whittenberger, R. T.; and Levin, J. H. "Preharvest Spray Cooling for Tart Cherries." *Mich. Agr. Expt. Sta.*, Res. Rpt. 69, p. 4, 1968.
- [6] Gaston, H. P.; Levin, J. H.; and Hedden, S. "Experiments in Harvesting Cherries Mechanically." *Mich. Agr. Expt. Sta. Quar. Bull.*, 41:805-11, 1959.
- [7] _____ ; Hedden, S. L.; Levin, J. H.; Whittenberger, R. T.; and Hammer, C. L. "Sweet Cherry Harvest Trials." *Western Fruit Grower*, Vol. 15, No. 7, pp. 23-24, 1961.
- [8] _____ ; Levin, J. H.; and Whittenberger, R. T. "How to Use Cherry Harvesting Machines." *Mich. Agr. Expt. Sta. Ext. Bull.*, 532, p. 2, 1966.
- [9] _____ ; Levin, J. H.; and Whittenberger, R. T. "Report on What's Been Done to Date in Mechanically Harvesting Sweet Cherries in Michigan." *Great Lakes Fruit Growers News*, Vol. 6, No. 5, pp. 12-14, 1967.
- [10] _____ ; Levin, J. H.; and Whittenberger, R. T. "Ten Years' Progress in Machine Harvesting Fruit - Where We Are Now and Where We Go From Here." *Mich. State Hort. Soc.*, 97th Ann. Rpt., 1967, pp. 54-59, 1968.
- [11] _____ ; McManus, G., Jr.; and Cargill, B. F. "Cooling Stations for Red Tart Cherry Orchards." *Mich. State Univ.*, *Farm Sci. Series Ext. Bull.*, 615, p. 6, 1968.
- [12] _____ ; Whittenberger, R. T.; and Levin, J. H. "Research Group Reports on Machine Harvesting of Michigan Grown Sweet Cherries." *Great Lakes Fruit Growers News*, Vol. 7, No. 3, pp. 14-16, 1968.
- [13] Guest, R.; Markwardt, E. D.; LaBelle, R. L.; and French, O. C. "Progress Report on Mechanical Harvesting of Red Tart Cherries." *N.Y. State Agr. Expt. Sta.*, p. 28, 1960.
- [14] LaBelle, R. L. "Cherry Scald - A Harvesting and Handling Problem." *Farm Res.*, N.Y. State Agr. Expt. Sta., Vol. 22, p. 15, April, 1956.
- [15] _____ ; Moyer, J. C.; Robinson, W. B.; and Hand, D. B. "Causes of Scald in Red Tart Cherries." *Food Technol.*, 12, pp. 94-98, 1958.
- [16] _____ . "Improvements in Harvesting, Handling, and Processing the Red Tart Cherry." *Great Lakes Cherry Producers Mktg. Coop., Inc.*, 1960 Progress Rpt., pp. 36-43, 1960.

- [17] _____. "Mechanical Harvest and Fruit Quality." *Farm Res.*, N.Y. State Agr. Expt. Sta., Vol. 27, No. 2, p. 11, 1961.
- [18] _____. "Product Quality in Mechanically Harvested Cherries and Apples." *Proc. 1963 Ann. Mtg., N. Y. State Hort. Soc.*, pp. 219-22, 1963.
- [19] _____; Woodams, E. E.; and Bourne, M. C. "Recovery of Montmorency Cherries from Repeated Bruising." *Proc. Amer. Soc. Hort. Sci.*, 84, pp. 103-9, 1964.
- [20] _____. "Controlling Cherry Scald." *Proc. N. Y. State Hort. Soc.*, pp. 117-123, 1965.
- [21] _____. "A New Processing Technique for Tart Red Cherries." *Farm Res.*, N.Y. State Agr. Expt. Sta., Vol. 31, No. 1, pp. 10-11, 1965.
- [22] _____. "How Growers and Processors Can Reduce Bruising and Scald of Mechanically Harvested and Handpicked Cherries." *Mich. State Hort. Soc.*, 95th Ann. Rpt., 1965, pp. 29-34, 1966.
- [23] _____, and Van Buren, J. P. "Maraschino and Candied Cherries - Some Aspects of Their Production." *Farm Res.*, N.Y. State Agr. Expt. Sta., Vol. 31, No. 4, pp. 2-3, 1966.
- [24] Larsen, R. "What We Know About Cultural Practices in Relation to Mechanical Harvesting That May Influence Cherry Quality." *Mich. State Hort. Soc.*, 94th Ann. Rpt., 1964, pp. 79-83, 1965.
- [25] Levin, J. H., and Gaston, H. P. "Grower Handling of Red Cherries." *U.S. Dept. Agr. Circ.*, No. 981, p. 20, 1956.
- [26] _____; Gaston, H. P.; Hedden, S. L.; and Whittenberger, R. T. "Mechanizing the Harvest of Red Tart Cherries." *Mich. Agr. Expt. Sta., Quar. Bull.*, 42:656-88, 1960.
- [27] Markwardt, E. D.; Guest, R. W.; Cain, J. C.; and LaBelle, R. L. "Mechanical Cherry Harvesting as Related to Costs, Product Quality, and Cultural Practices." *Amer. Soc. Agr. Engr.*, 1962 Ann. Mtg., Paper No. 62-156, p. 31, 1962.
- [28] Norton, R. A.; Claypool, L. L.; Leonard, S. J.; Adrian, P. A.; Fridley, R. B.; and Charles, R. M. "Mechanical Harvesting of Sweet Cherries - 1961 Tests Show Promise and Problems." *Calif. Agr., Calif. Agr. Expt. Sta.*, Vol. 16, No. 5, pp. 8-10, 1962.
- [29] Stebbins, R. L.; Cain, R. F.; and Watters, G. "Mechanical Harvesting of Sweet Cherries in Oregon." *Ext. Tree Fruit Specialists' Newsletter, Ore. State Univ.*, Vol. 6, No. 5, pp. 1-11, 1967.
- [30] Tennes, B. R.; Diener, R. G.; Levin, J. H.; and Whittenberger, R. T. "Firmness and Pitter Loss Studies on Tart Cherries." *Amer. Soc. Agr. Engr.*, 60th Ann. Mtg., Paper No. 333, p. 14, 1967.
- [31] _____; Anderson, R. L.; and Levin, J. H. "Weight to Volume Relationship of Tart Cherries." *Res. Rpt., Mich. Agr. Expt. Sta.*, 70, p. 4, 1968.
- [32] Thienes, J. R. "Sweet Cherry Mechanical Harvesting Looks Good in Oregon and Michigan." *Mich. State Hort. Soc.*, 97th Ann. Rpt., 1967, pp. 59-64, 1968.

- [33] Whittenberger, R. T. "Factors Which Affect the Drained Weight and Other Characteristics of Heat-processed Red Cherries." *Food Research*, 17:299-306, 1952.
- [34] _____, and Hills, C. H. "Studies on the Processing of Red Cherries. I. Changes in Fresh Red Cherries Caused by Bruising, Cooling, and Soaking." *Food Technol.*, 7:29-31, 1953.
- [35] _____, and Hills, C. H. "Bruising Causes Cherry Discoloration." *Canner and Freezer*, Vol. 123, No. 4, pp. 14-15, 1956.
- [36] _____. "Bruising of Red Cherries." *Canner and Freezer*, Vol. 126, No. 10, p. 33, 1958.
- [37] _____, and Hills, C. H. "Minnow Net Reduces Cherry Bruising." *Amer. Fruit Grower*, Vol. 78, No. 10, p. 11, 1958.
- [38] _____, and Hills, C. H. "Bruising of Red Cherries in Relation to The Method of Harvest." *U.S. Dept. Agr., Agr. Res. Serv.*, 73-27, p. 14, 1960.
- [39] _____; Gaston, H. P.; Hedden, S. L.; and Levin, J. H. "Processing Mechanically Harvested Cherries in 1962. Quality and Cost Comparisons." *Great Lakes Cherry Producers Mktg. Coop., Inc., 1962 Progress Rpt.*, pp. 10-19, 1962.
- [40] _____; Gaston, H. P.; and Levin, J. H. "Effect of Recurrent Bruising on the Processing of Red Tart Cherries." *Res. Rpt., Mich. Agr. Expt. Sta.*, 4, p. 6, 1964.
- [41] _____; McAdoo, D. J.; Gaston, H. P.; and Levin, J. H. "Electric Sorting Machines for Tart Cherries: Performance Studies in 1963." *U.S. Dept. Agr., Agr. Res. Serv.*, 73-45, p. 8, 1964.
- [42] _____; Levin, J. H.; and Gaston, H. P. "Electric Sorters and Destemmers for Tart Cherries Score Advances." *Canner/Packer*, Vol. 134, No. 4, pp. 53-54, 1965.
- [43] _____; Levin, J. H.; Wolthuis, R. J.; and Gaston, H. P. "How Much Beating Will Your Tart Cherries Take and Where Do They Get It?" *Mich. State Hort. Soc., 94th Ann. Rpt.*, 1964, pp. 83-87, 1965.
- [44] _____; Harris, M. B.; Hills, C. H.; and Levin, J. H. "Many Factors Affect Cherry Scald." *Canner/Packer*, Vol. 136, No. 7, p. 34, 1967.
- [45] _____; Levin, J. H.; and Gaston, H. P. "Following Cherry Quality From the Tree To the Can." *Mich. State Hort. Soc., 97th Ann. Rpt.*, 1967, pp. 65-69, 1968.
- [46] _____. "How to Control Cherry Scald in 1968." *Proc. 113th Ann. Mtg., N. Y. State Hort. Soc.*, pp. 117-20, 1968.
- [47] _____; Harrington, W. O.; and Hills, C. H. "Aeration and Cherry Scald - 1967 Results." *Canner/Packer*, Vol. 137, No. 7, p. 33, 1968.
- [48] _____; Levin, J. H.; and Gaston, H. P. "Maintaining Quality by Brining Sweet Cherries After Harvest." *Res. Rpt., Mich. Agr. Expt. Sta.*, 73, p. 4, 1968.